

# S. A. M.

## The Software Automatic Mouth

FOR THE ATARI 400/800

## OWNER'S MANUAL



**DON'T ASK**  
COMPUTER SOFTWARE



# S. A. M.

## The Software Automatic Mouth

Written by  
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S.A.M. and Reciter programs  
Documentation and packaging  
(c) 1982 — Don't Ask, Inc.



S.A.M. character designed by Gunnar Kullenberg



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## TABLE OF CONTENTS

INTRODUCTION	4
THE S.A.M. DISKETTE	5
USING THE S.A.M. PROGRAMS	6
RUNNING THE DEMO PROGRAMS	6
USING S.A.M. FROM ATARI BASIC	7
USING RECITER FROM ATARI BASIC	8
USE OF S.A.M. AND RECITER FROM MACHINE LANGUAGE	8
THE RECITER PROGRAM	9
I. THE PHONETIC SPELLING SYSTEM	10
PHONEME CHART	11
II. ADDING STRESS TO S.A.M.'S SPEECH	13
III. THE EFFECTS OF PUNCTUATION	15
IV. FINAL NOTES ON PHONETIC INPUT	15
THE USE OF PITCH AND SPEED CONTROLS	16
WHAT AM I HEARING?	17
ENGLISH-TO-PHONETIC SPELLING DICTIONARY	19
FINDING PHONEME SPELLING ERRORS	34
TECHNICAL NOTES	34
IMPORTANT ADDRESSES	35
LISTING OF GUESSNUM	36
FUTURE IMPROVEMENTS	38

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Information on compatibility with specific products may from time-to-time become available upon request from DON'T ASK.

## INTRODUCTION

### **Congratulations!**

You have just purchased S.A.M. — the Software Automatic Mouth — a versatile, high-quality speech synthesizer created entirely in software. You have added quality speech to your personal computer for a lower cost than ever before possible and, in the bargain, have gained features that other speech synthesizers cannot offer.

S.A.M. is designed to be easy to use. With a couple of simple program statements, you can add speech to your BASIC or assembly-language programs. When you have mastered the easy-to-learn phonetic alphabet, the inflection system, and the use of pitch and speed controls, you will be amazed at what you can make S.A.M. do. And, until then it will already match the performance of other speech synthesizers.

We strongly suggest that you read this manual carefully while learning to use S.A.M. There are thorough discussions of S.A.M.'s features with illustrative examples of how to implement them. There is also a dictionary of useful words and their phonetic equivalents to help you learn the phonetic spelling system.

Also remember that as a registered S.A.M. owner, you are entitled to our services in answering your S.A.M.-related questions, providing updates and improvements to the S.A.M. program at nominal cost, and helping you with your applications of S.A.M. Yes, this is a not-too-subtle hint that you should send in your S.A.M. owner registration card today. We look forward to hearing from you.

## THE S.A.M. DISKETTE

The S.A.M. diskette contains several programs.

### **1. The S.A.M. speech synthesis program —**

This program will boot in automatically and will leave your computer ready to accept speech input through BASIC or machine language programs. The program occupies about 9K bytes.

### **2. RECITER —**

RECITER is the English text-to-speech program that interfaces the S.A.M. program with ordinary English text input. It is **not** used for phonetic input and must be loaded in separately (see instructions). It occupies about 6K bytes.

### **3. SAYIT —**

A short BASIC program that allows you to type in strings of phonemes or text and hear them spoken immediately.

### **4. DEMO —**

A BASIC program that demonstrates some of S.A.M.'s features by telling a short story.

### **5. SPEECHES —**

Another BASIC program that features some familiar texts to be spoken aloud by S.A.M.

### **6. GUESSNUM —**

A vocal version of the old guess-the-number-between-one-and-one-hundred game. Great for kids.

We suggest that you do not write additional data on the S.A.M. diskette. Remove it after loading the desired programs.

## USING THE S.A.M. PROGRAMS

The S.A.M. program itself is a self-contained machine-language program that automatically boots in from the S.A.M. diskette when a system cartridge (e.g. BASIC or ASSEMBLER) is in the left slot. Programs using S.A.M. in the phonetic mode can be run immediately at this point.

In order to allow maximum working space in Atari memory, S.A.M. has been installed in a location that conflicts with some functions of the Atari DOS 2.0S operating system. In particular, when the DOS menu must be accessed, such as to load the RECITER program or the RS232 handler, special care must be taken. We therefore ask you to take the following steps:

1. Format a blank diskette using DOS 2.0S (S.A.M. is **incompatible** with other versions of DOS) and write the DOS files to the disk with the "H" option in DOS. **DO NOT** use the DOS from the S.A.M. disk to create the copy disk; use DOS from another disk.
2. Copy the programs from the S.A.M. diskette onto this new disk using the "O" (duplicate file) command followed by \*\* to copy all the files (the "J" command will not work). The S.A.M. program will **not** be transferred to the new disk.
3. Make sure there is a MEM.SAV file on your copy disk and always leave it **un-write-protected**.
4. To use S.A.M. in conjunction with DOS, boot the S.A.M. disk. Then remove it and place the copy disk you have created into your drive. Then type "DOS" to enter the DOS menu. You can now load machine language files such as RECITER via the "L" command in DOS. Just remember that in order to use DOS with S.A.M. in the system, there **must** be a MEM.SAV on the disk. To return to BASIC after loading in a file, use the "B" command. (See the DOS 2.0S manual for further information on the use of MEM.SAV.)

We have included a S.A.M.-and-RECITER-compatible bootstrap for the RS232C handler on the S.A.M. diskette. Binary load it from DOS exactly as you do with RECITER if you need to use the RS232 interface along with S.A.M.

The RS232 handler provided will only function if RECITER is already loaded in. It will not work with S.A.M. alone.

## RUNNING THE DEMO PROGRAMS

Once S.A.M. is loaded into memory, you can run all four demo programs on the S.A.M. disk (SAYIT, DEMO, SPEECHES, and GUESSNUM). These are all Atari BASIC programs and run from the usual BASIC "RUN" command. To operate SAYIT with English input, make sure you have binary-loaded RECITER as well.

## USING S.A.M. FROM ATARI BASIC

S.A.M. patches into Atari BASIC by the use of the reserved string variable named SAM\$ (easy to remember).

Two BASIC statements are all that are required to make S.A.M. speak. The following statements inserted anywhere in an Atari BASIC program will cause S.A.M. to speak the phrase "I am a computer".

```
100 SAM$ = "AY4 AEM AH KUMPYUW3TER."  
110 A = USR (8192)
```

By using Atari BASIC'S string handling capabilities, it is possible to generate the SAM\$ string from sentence fragments, data statements, text files, etc. Just make sure the SAM\$ string is DIMensioned in your program (it can be DIMensioned no more than 255 characters long). The GUESSNUM program listed in this manual illustrates some of the techniques of using S.A.M. in BASIC.

### SOME ADDITIONAL NOTES:

1. To avoid stepping on S.A.M. with your Atari BASIC program, do not make any changes in the value of LOWMEM.
2. S.A.M. makes use of the "zero" sound register in the Atari (location \$D201). You may use the other three sound registers undisturbed during vocal output. S.A.M. has no effect on Atari graphics modes other than using up memory that might be needed for large programs requiring high resolution (e.g. GR.8) graphic display.
3. S.A.M. disables interrupt requests and shuts down the ANTIC chip during vocal output. Therefore, the screen will blank out and the BREAK key will not operate while S.A.M. is speaking. See the Technical Notes for more details.

## **USING RECITER FROM ATARI BASIC**

To use RECITER from Atari BASIC, follow this procedure:

1. Boot S.A.M. in from the S.A.M. diskette.
2. Enter DOS from a disk containing MEM.SAV and RECITER (see page 6).
3. Type "L" for Binary Load.
4. Type "RECITER".
5. When the DOS prompt returns, type "B" to get back into BASIC.
6. You are ready to use RECITER in your programs or in SAYIT.

Using RECITER from Atari BASIC is the same as using S.A.M. in his phonetic mode. However, this time the string SAM\$ is in plain English. Also the calling address is different.

100 SAM\$ = "I AM A COMPUTER."

110 A =USR(8199)

Use of punctuation with RECITER is discussed later, but note that a dash will be treated as a pause-making dash only if there is non-letter (not A-Z) on both sides of it. Examples: the dash in "YOU ARE A RAT-FINK" will not pause, but the dash in "HELLO JIM - THIS IS ANN" will.

## **USE OF S.A.M. AND RECITER FROM MACHINE LANGUAGE**

This is very similar to using S.A.M. from Atari BASIC except for one change; you must do your own string handling. A string of ATASCII characters (the same ones you would use in BASIC) is moved into locations \$2014-2113. The first character must be in \$2014 and the last character, an \$9B return character, marks the string's end. Bytes after the \$9B are not read by S.A.M. Following the string definition, a JSR \$2004 is done and S.A.M. speaks. The use of RECITER is the same except that you do a JSR \$200B instead.

## THE RECITER PROGRAM

RECITER is an English text-to-speech program that converts ordinary text into phonemes that S.A.M. can understand. You simply supply output strings of 256 characters or less to the program. RECITER takes care of the rest.

The program uses about 450 rules to convert English into S.A.M.'s phonetic language. Included among these rules are some stress markers for situations where the stress choice is unambiguous. In addition, S.A.M.'s usual punctuation rules still operate with some additional symbols ("!", ";" and ":") being considered as periods. The net result is that even directly-translated English text has a fair amount of inflection.

RECITER also recognizes a number of special characters. Numbers are read aloud, and several others are pronounced as well. If a character is not understood by RECITER, it simply isn't passed to S.A.M.

We recommend use of RECITER (or any text-to-speech program, for that matter) only for applications where the user has no control of the text. For example, text already in a file, text received over a MODEM, and text supplied by users unfamiliar with the phonetic system. Where the highest quality speech with full inflection is desired, we urge you to use S.A.M.'s phonetic system.

Don't be discouraged, though. You will find that RECITER will do a better job of speaking from English text than other text-translator products.

## THE SAYIT PROGRAM

SAYIT is a short BASIC program that allows you to test many of S.A.M. and RECITER's features by directly inputting the string SAM\$.

If both S.A.M. and RECITER have been loaded in, you may opt for English input when running the program.

Typing "ctrl-N" will allow you to input new pitch and speed values to test these features. Once you have done so, the new pitch and speed will remain until you type "ctrl-N" again.

## PHONETIC INPUT TO S.A.M.

### I. THE PHONETIC SPELLING SYSTEM

S.A.M. is equipped with a version of the easy-to-learn, very readable International Phonetic Alphabet. There are about fifty phonemes which will let you spell all the words in English. Some sounds from foreign languages are not available in the system at this time.

Why use the phonetic system? There are two compelling reasons. 1.) In the phonetic system, all the words will be pronounced correctly; and 2.) You can put inflection into the speech however and wherever you want it.

If you have already tried the RECITER text-to-speech program, you know that it does a fair job of pronouncing English words. However, it does make mistakes. Some words sound a little strange and others are difficult to understand. The reasons for this are not hard to understand. English is a language of exceptions rather than rules; words that are spelled alike are pronounced differently ("have" vs. "gave"). A rule system like RECITER cannot pronounce all words correctly unless it stores an enormous dictionary that takes up vast amounts of memory. But the second flaw in text-to-speech conversion is more serious. Such a rule system cannot decide where the stress belongs in what is being said. The phonetic system in S.A.M., on the other hand, allows you to decide where to accent syllables within a word and where to stress words within a sentence.

So it is clear that the preferred way to make S.A.M. speak is with the phonetic alphabet. But how hard is it to use? It's really easier than writing in English because you don't have to know how to spell! You only have to know how to say the word in order to spell it phonetically.

Here is the complete list of phonemes, each presented with a sample word containing its sound. Note that there are many vowels, which is why they are all indicated by two letters rather than one.

The phonemes are classified into two categories: vowels and consonants. Among the vowels are the simple vowel sounds such as the "i" in "sit", the "o" in "slot", and the "a" in "hat". These vowels do not change their quality throughout their duration. There are also vowels called diphthongs such as the "i" in "site", the "o" in "slow", and the "a" in "hate", as well as the "oi" in "oil" and the "ow" in "how". These vowels start with one sound and end with another (e.g. "oi" glides from an "oh" sound to an "ee" sound).

The consonants are also divided into two groups: voiced and unvoiced. The voiced consonants require you to use your vocal chords to produce the sound. Such sounds as "b", "l", "n", and "z" sounds fall into this category. The unvoiced consonants, on the other hand, are produced entirely by rushing air and include such sounds as the "p", "t", "h", and "sh" sounds.

# PHONETIC ALPHABET FOR S.A.M.

The example words have the **sound** of the phoneme, not necessarily the same letters.

## VOWELS

<b>IY</b>	feet
<b>IH</b>	pin
<b>EH</b>	be <sup>g</sup>
<b>AE</b>	Sam
<b>AA</b>	pot
<b>AH</b>	budget
<b>AO</b>	talk
<b>OH</b>	cone
<b>UH</b>	book
<b>UX</b>	loot
<b>ER</b>	bird
<b>AX</b>	gall <sup>o</sup> n
<b>IX</b>	digit

## DIPHTHONGS

<b>EY</b>	made
<b>AY</b>	high
<b>OY</b>	boy
<b>AW</b>	how
<b>OW</b>	slow
<b>UW</b>	crew

## VOICED CONSONANTS

<b>R</b>	red
<b>L</b>	allow
<b>W</b>	away
<b>WH</b>	whale
<b>Y</b>	you
<b>M</b>	Sam
<b>N</b>	man
<b>NX</b>	song
<b>B</b>	bad
<b>D</b>	dog
<b>G</b>	again
<b>J</b>	judge
<b>Z</b>	zoo
<b>ZH</b>	pleasure
<b>V</b>	seven
<b>DH</b>	then

## UNVOICED CONSONANTS

<b>S</b>	Sam
<b>SH</b>	fish
<b>F</b>	fish
<b>TH</b>	thin
<b>P</b>	poke
<b>T</b>	talk
<b>K</b>	cake
<b>CH</b>	speech
<b>/H</b>	ahead

The following symbols are used internally by some of S.A.M.'s rules, but they are also available to the user.

<b>YX</b>	diphthong ending
<b>WX</b>	diphthong ending
<b>RX</b>	R after a vowel
<b>LX</b>	L after a vowel
<b>/X</b>	H before a non-front vowel or consonant
<b>DX</b>	"flap" as in pity

## SPECIAL PHONEMES

<b>UL</b>	settle (= AXL)
<b>UM</b>	astronomy (= AXM)
<b>UN</b>	function (= AXN)
<b>Q</b>	kitt-en (glottal stop)

Note: The symbol for the "H" sound is **/H**. A glottal stop is a forced stoppage of sound.

On the phoneme chart, you will notice six phonemes — YX, WX, RX, LX, /X, and DX — which are described as being used by S.A.M.'s rule system. However, they have been provided with letter codes so that you may experiment with these special sounds directly. YX and WX are weaker versions of Y and W. RX and LX are smooth gliding versions of R and L. /X is the "h" sound in "who", and DX is the quick flap of the tongue on the upper palate as in the word "pity".

We are now ready to transcribe ordinary speech into its phonetic representation. Let's use the following sentence as an example:

### **I do my calculations on the computer.**

The first step is to say each word aloud and decide how many syllables are in the word. A syllable has **one** vowel phoneme and its associated consonants (if any). We then identify the proper vowel phoneme by comparing its sound to the sounds listed in the table, and do the same for the consonants. The resultant combination of phonemes is the phonetic representation of the syllable. We do this for each syllable in a word.

In our example, the first word — "I" — is a single phoneme, the diphthong "AY". The next word — "do" — is a single syllable comprised of the diphthong "UW" preceded by the voiced consonant "D". The phonetic spelling is therefore "DUW". Similarly, the third word — "my" — again uses the "AY" sound, this time preceded by an "M", resulting in "MAY".

The word "calculations" has four syllables. The first syllable transcribes as "Kael". The "c" sound is pronounced as "k", unlike the "s" pronunciation in a word like "cell" (notice there is no "C" in the phoneme table). The next syllable — "cu" — transcribes as "KYUW". Note here that the "Y" sound prevents this syllable from being pronounced as "coo". The third syllable comes out as "LEY", and the fourth becomes "SHAXNZ". This word ends with a voiced sound "Z" and not the hissy "S" sound as in "list". You will rapidly discover that many words contain the phonetic combinations "AXL", "AXM", and "AXN". To enhance the readability of the phonetic spelling, the special symbols "UL", "UM", and "UN" can be substituted for these combinations. The "tions" syllable is now written as "SHUNZ". So, "calculations" becomes "KaelKYUWLEYSHUNZ".

The next word "on" becomes "AAN", and "the" becomes "DHAX". By the way, if the word "the" precedes a word beginning with a vowel, it gets pronounced "thee" and is spelled "DHIY". You should also notice that the "th" letter combination has two phonetic representations: unvoiced (TH) as in "thin", or voiced (DH) as in "the".

By now, the steps used in getting from "computer" to "KUMPYUWTER" should already be obvious. Try it.

Once you get used to the phonetic system, it will seem very easy and obvious. Initially, there will be some spellings that seem tricky (did you know that "adventure" has a "CH" in it?). However, the rule is always to write the word the way you **say** it, not the way you spell it.

To help you learn the system fast, we have provided an English-to-phonetic spelling dictionary of almost 1500 words. Many common words are in the dictionary; some unusual ones are in it as well. If you are really stuck on how to spell a word that isn't in the dictionary, think of another word that sounds like it and that one may be listed.

In any case, don't hesitate to experiment with the phonetic spelling system. Let your ears be your guide. This system is easy to learn, easy to use, easy to read, and you will be amazed at what you can do with it.

## **II. ADDING STRESS TO S.A.M.'S SPEECH**

In the phonetic mode, S.A.M. is capable of speaking with a great deal of inflection and emphasis. This gives a much more natural and understandable quality to the speech than is otherwise possible.

The stress system for S.A.M. is particularly easy to use. There are eight stress markers that can be used simply by inserting a number (1-8) **after** the vowel to be stressed. For example, the monotonic pronunciation of the word "hello" produced by the phonetic spelling "/HEHLOW" becomes a much friendlier sounding greeting when spelled "/HEH3LOW".

Why do you have to put in the stress markers? Simply because they can go **anywhere** and S.A.M. has no way of knowing where you **want** them to go. The following simple example will demonstrate this point to you. Use the SAYIT program on your S.A.M. disk to hear the following sample phrases.

We will have S.A.M. say

**"Why should I walk to the store?"**

in a number of different ways.

1. WAY2 SHUH7D AY WAO5K TUX DHAH STOH5R.  
(You want a reason to do it.)
2. WAY7 SHUH2D AY WAO7K TUX DHAH STOH5R.  
(You are reluctant to go.)
3. WAY5 SHUH7D AY2 WAO7K DHAH STOHR.  
(You want someone else to do it.)
4. WAY5 SHUHD AY7 WAO2K TUX7 DHAH STOHR.  
(You'd rather drive.)
5. WAY5 SHUHD AY WAO5K TUX DHAH STOH2OH7R.  
(You want to walk somewhere else.)

Each of these stress examples has a slightly different meaning, even though the words are all the same. Stress markers give you the ability to let S.A.M. be expressive.

What do the stress markers do? The number you type tells S.A.M. to raise (or lower) his pitch and elongate the associated vowel sound.

The number system works like this:

- 1 = very emotional stress
- 2 = very emphatic stress
- 3 = rather strong stress
- 4 = ordinary stress
- 5 = light stress
- 6 = neutral (no pitch change) stress
- 7 = pitch-dropping stress
- 8 = extreme pitch-dropping stress

When should you use each of these? It all depends on how you want S.A.M. to sound. Say the words to yourself as expressively as you can and see where **your** voice rises and falls. Remember, the smaller the number, the more extreme the emphasis will be. Also, the stress markers will help get difficult words pronounced correctly. If some syllable is not enunciated sufficiently, put in a neutral stress marker.

A general rule is that the most important word or words in a sentence get the most stress and the rest of the words get little or no stress. However, words of more than one syllable should have stress marked on their accented syllables (most dictionaries show which these are if you are uncertain).

We will now assign stresses to our first example sentence about doing calculations on the computer. The first word "AY" is usually an important word (can you think of anyone more important?). We will write it as "AY4", assigning ordinary stress. "DUW", the only verb, is also important. We'll try "DUW4". "MAY" isn't very strong (unless you want to draw attention to it) and it is a single syllable, so we will leave it alone. "KAEULKYUWLEYSHUNZ" is polysyllabic so we **must** identify the accented syllables. It is also the most important word in the sentence so it will have the strongest stress. "LEY" has the primary stress and "KAE" receives the secondary stress, so we will write "KAE4LKUYUWLEY3SHUNZ". "AAN" and "DHAX" are short, unstressed words. "KUMPYUWTER" has a single accent on "PYUW" and gets written "KUMPYUW4TER". So, our original sentence gets written

**AY4 DUW4 MAY KAE4LKUYUWLEY3SHUNZ AAN DHAH KUMPYUW4TER.**

Try typing it into the SAYIT program compared to the unstressed version.

How about really unusual stress? When you place extraordinary emphasis on a word, you do so by elongating its vowel sounds. S.A.M. can do the same thing. For example, a call for help can become "/HEH5EH4EH3EH2EH2EH3EH4EH5EHLP." You can always do this with the ordinary vowel sounds, but be careful with the diphthongs. They are complex sounds and if you repeat them, they will not do what you want (e.g. "OYOYOYOYOYOY" sounds just like it reads in English). To extend the diphthong sounds, you need to break them into component parts. So "OY" can be extended with "OHOHIYIYIY", and "AY" can be extended with "AAAIIYIYIY". You should experiment to find out just what you can do.

Unlike many other speech synthesis systems, S.A.M. allows you to control consonant stresses directly. This is usually done to produce a special tonal pattern in a word. Sometimes you might want a pitch rise on the final phoneme occurring just before a comma. For example, try typing: "AY4 YUWZ SAE5M3, AE4ND RIYSAY4TER." Notice how the pitch rises on the "M". It is never necessary to specify stress for a consonant occurring immediately before a stressed vowel. This is handled automatically.

Try to become familiar with the stress marker system. It makes all the difference between an ordinary speech synthesizer and the very expressive S.A.M.

### **III. THE EFFECTS OF PUNCTUATION**

S.A.M. understands four punctuation marks. They are the hyphen, comma, period, and question mark.

The hyphen (-) serves to mark clause boundaries by inserting a short pause in the speech. It also has other uses to be discussed later. The comma marks phrase boundaries and inserts a pause approximately double that of the hyphen. The question-mark and period mark the end of sentences. The period inserts a pause and also causes the pitch to fall. The question-mark also inserts a pause, but it causes the pitch to rise. Notice that not all questions should end with a question-mark (rising pitch), only those that require a yes-or-no answer. ("Are we hiking today?" rises; "Why are we going to the woods?" falls at the end and should be marked with a period).

### **IV. FINAL NOTES ON PHONETIC INPUT**

S.A.M. is capable of speaking only 2.5 seconds of speech without a break (this is the size of his "breath"). If the string to be spoken exceeds this, S.A.M. will insert short breaks every 2.5 seconds. S.A.M. **always** breaks at punctuation marks in anticipation of the following phrase. So, if you don't like where S.A.M. broke up a phrase, you can specify your own breaks with hypens. An example of this is: "I use the telephone - to call out of town".

S.A.M. uses the spaces between words to make his sentence-breaking decisions. If a single word requires more than 2.5 seconds to say, S.A.M. will not be able to insert his own breaks and will therefore be unable to say the word.

In summary, the procedures outlined above may seem complex, but this is because they were presented in fine detail. In reality, the steps become automatic and you will soon be able to type in phonetics almost as fast as you can type English text.

## THE USE OF PITCH AND SPEED CONTROLS

S.A.M. is capable of speaking in a wide range of tones and at many different rates. Both pitch and speed controls are accessed by single POKES to memory locations.

The following chart shows the effects of different values in the pitch and speed registers.\*

### PITCH

POKE PITCH, N

N=

00-20	impractical
20-30	very high
30-40	high
40-50	high normal
50-70	normal
70-80	low normal
80-90	low
90-255	very low

default = 64

### SPEED

POKE SPEED, M

M=

0-20	impractical
20-40	very fast
40-60	fast
60-70	fast conversational
70-75	normal conversational
75-90	narrative
90-100	slow
100-225	very slow

default = 72

\*see the memory reference chart for these locations

## WHAT AM I HEARING?

In recent years, many new speech synthesizers have appeared in the marketplace. The techniques they use vary widely depending on the intended application. Most synthesizers found in consumer products, such as talking televisions or microwave ovens, use a "speech compression" technique of one sort or another. These techniques require a person to speak the needed words or entire sentences. The speech waveform is then "compressed" using a mathematical algorithm and, as a result, can then be stored in a memory chip without taking up a lot of room. The synthesizer's job is to then take this compressed speech information and expand it back into the original waveform. Some of these systems work quite well, retaining the speaker's intonation and sometimes even his or her identity. The processes used in such synthesizers differ greatly from those used in unlimited vocabulary synthesizers like S.A.M.

Let's follow the evolution of an unlimited vocabulary speech synthesizer. First, we must define the task. Simply, we want to create a system that will synthesize any English utterance. One way to begin would be to record every possible utterance on tape and just play back the right one whenever we need it. This would take up more tape or computer memory than could ever exist, so this method is obviously not too practical.

The next method might be to record all the English words and play them back in a specific order to create sentences. This is certainly practical. It would take up a large amount of memory, but it would work. However, we have lost something in this process. The words now sound disjointed because we have "spliced" the sentence together. Also, the stress or inflection pattern of the sentence is either wrong or non-existent. If we wanted an accurate stress pattern, we would need to record every word in a number of different styles, at different pitches, etc.

Such a system needs too much memory. So, let's break things down even further and try to store as little as possible in memory. Instead of storing sentences or words or even syllables, we could store phonemes. Phonemes are the atoms of spoken language, the individual speech sounds. It turns out that English has a little over forty of them. Wow — this takes up practically no memory at all! We could specify the phonemes in the order we need to create words and sentences and really have ourselves a system. So, we go and record the phonemes and play them back to say the sentence, "I am a computer." Why can we barely understand it? It seems we have broken things down a bit too far. When we chop the words down to this level and then try to reassemble them, everything that blends one sound into another is lost and the results are nothing less than horrible.

But all is not lost. Our efforts are not wasted because we have the acoustic-phonetician to come to our rescue. These people deal in the study of speech sounds and they can tell us just how to repair our phoneme-based system. First, instead of recording the actual speech waveform, we only store the frequency spectrums. By doing this, we save memory and pick up other advantages. Second, we learn that we need to store some data about timing. These are numbers pertaining to the duration of each phoneme under different circumstances, and also some data on transition times so we can know how to blend a phoneme into its neighbors. Third, we devise a system of rules to deal with all this data and, much to our amazement, our computer is babbling in no time.

The advantages in synthesizing speech in this way are tremendous. We use very little memory for all the data and the rules to use that data, and we also gain the ability to specify inflection, timing, and intonation. This is because we have not stored actual speech sounds, only their spectrums. (You can think of this as a printer needing only four colors of ink to reproduce all the colors in a picture.)

Now, in actuality, we do not store all the spectrums, but only those that are targets. Each phoneme has associated with it a target spectrum which can be specified with very little data. The target may be thought of as a "frozen" speech sound, the sound you would be making if your mouth was frozen exactly in the middle of pronouncing the phoneme. The timing rules tell the synthesizer how to move from target to target in a manner that imitates the timing of a human talker.

S.A.M. is this type of synthesizer implemented entirely in software. It has the tables of phoneme spectra and timing, together with the rules for using this data to blend the sounds together into any English utterance we may have in mind. We have traded some quality from the method using all the recorded words, but what we have gained is versatility, practicality, and the ability to do it all in real time, with very little memory usage, on an inexpensive microcomputer.

# ENGLISH-TO-PHONETIC SPELLING DICTIONARY

## - A -

abandon = AHBAE4NDUN  
ability = AHBH4LIXTIY  
able = EY4BUL  
abort = AHBOH4RT  
about = AHBAW4T  
above = AHBAA4V  
absolute = AE5BSOHLUW4T  
abuse = AHBYUW4S  
accelerate = EHKSEH4LEREYT  
accent = AE4KSEHNT  
accept = AEKSEH4PT  
access = AE4KSEHS  
accident = AE4KSIXDEHNT  
account = AHKAW4NT  
acknowledge = EHKNAA4LIHJ  
action = AE4KSHUN  
active = AE4KTIHV  
address = AE4DREHS  
adjust = AHJAH4ST  
adult = AHDAH4LT  
advance = EHDVAE4NS  
adventure = AEDVEH4NCHER  
affair = AHFEY4R  
afford = AHFOH4RD  
after = AE4FTER  
age = EY4J  
agree = AHGRIY4  
air = EH4R  
airplane = EH4RPLEYN  
alarm = AHLAA4RM  
algebra = AE4LJAXBRAH  
alien = EY4LIYIXN  
allow = AHLAW4  
alone = AHLOW4N  
along = AHLAO4NX  
alphabet = AE4LFAXBEHT  
alternate = AO4LTERNIXT  
America = AHMEH4RICKAH  
among = AHMAH4NX  
analysis = AHNAE4LIXSIXS  
and = AE4ND  
anger = AE4NXGER  
announce = AHNAW4NS  
answer = AE4NSER  
antenna = AENTEH4NAH  
anticipate = AENTIH4SIXPEYT  
apology = AHPAA4LAXJIY  
appear = AHPYI4R  
apple = AE4PUL  
appropriate = AHPROH4PRIYIXT

approve = AHPRUW4V  
area = EH4RIYAH  
arm = AA4RM  
arrive = AHRAY4V  
ask = AE4SK  
assumption = AHSAH4MPSHUN  
astronomy = AHSTRAA4NUMIY  
Atari = AHTAA4RIY  
atom = AE4TUM  
attack = AHTAE4K  
audio = AO4DIYOW  
authority = AHTHOH4RIXTIY  
automatic = AO5TUMAE4TIXK  
auxiliary = AOKZIH4LYERIY  
available = AHVEH4LAXBUL

## - B -

baby = BEY4BIY  
back = BAE4K  
bad = BAE4D  
balance = BAE4LIXNS  
bank = BAE4NXK  
bargain = BAA4RGUN  
base = BEY4S  
basic = BEY4SIHK  
battle = BAE4TUL  
beam = BIY4M  
beautiful = BYUW4TIXFUHL  
behave = BIY4HEY4V  
belief = BIXLIY4F  
beneficial = BEH4NAXFIH4SHUL  
betray = BIYTREY4  
better = BEH4TER  
bible = BAY4BUL  
bibliography = BIH5BLIYAA4GRAXFIY  
bicycle = BAY4SIXKUL  
billion = BIH4LYUN  
binary = BAY4NEHRIY  
bite = BAY4T  
black = BAE4K  
blast = BLAE4ST  
block = BLAA4K  
blood = BLAH4D  
board = BOH4RD  
bomb = BAA4M  
book = BUH4K  
boot = BUW4T  
boss = BAO4S  
bottle = BAA4TUL  
bottom = BAA4TUM  
box = BAA4KS

boy = BOY4  
brain = BREY4N  
branch = BRAE4NCH  
break = BREY4K  
brief = BRIY4F  
bring = BRIH4NX  
broken = BROW4KIXN  
brother = BRAH4DHER  
budget = BAH4JIXT  
buffer = BAH4FER  
bug = BAH4G  
bureau = BYER4OW  
burglar = BER4GULER  
bus = BAH4S  
business = BIH4ZNIXS  
busy = BIH4ZIY  
by = BAY4  
byfe = BAY4T

- C -

cabinet = KAE4BUNIXT  
cable = KEY4BUL  
calculate = KAE4LKAYALEYT  
calendar = KAE4LUNDER  
call = KAO4L  
calorie = KAE4LERIY  
cancel = KAE4NSUL  
candy = KAE4NDIY  
can't = KAE4NT  
capacity = KAXPAE4SIXTIY  
captain = KAE4PTIXN  
capture = KAE4PCHER  
card = KAA4RD  
careful = KEH4RFUHL  
carry = KEH4RIY  
cartridge = KAA4RTRIXJ  
case = KEY4S  
cashier = KAE4SHIY4R  
cassette = KAXSEH4T  
catalog = KAE4TULAOG  
celebrate = SEH4LAXBREYT  
celestial = SULEH4SCHIYUL  
Celsius = SEH4LSIYAXS  
center = SEH4NTER  
certain = SER4TQN  
challenge = CHAE4LIXNJ  
change = CHEY4N  
channel = CHAE4NUL  
chapter = CHAE4PTER  
charge = CHAA4RJ  
chauvenism = SHOH4VIXNIHZUM

cheap = CHIY4P  
cheese = CHIY4Z  
child = CHAY4LD  
children = CHIH4LDRIXN  
chocolate = CHAO4KLIXT  
choreography = KOH5RIYAA4GRAXFIY  
Christmas = KRIH4SMAKS  
church = CHER4CH  
cinema = SIH4NUMAH  
circle = SER4KUL  
circuit = SER4KIXT  
circumstance = SER4KUMSTAENS  
citizen = SIH4TIXSUN  
city = SIH4TIY  
classify = KLAE4SIXFAY  
clear = KLIY4R  
close = KLOW4Z  
coaxial = KOHAE4KSIYUL  
coffee = KAO4FIY  
coherent = KOW/HEH4RIXNT  
cold = KOW4LD  
college = KAA4LIXJ  
color = KAH4LER  
comfortable = KAH4MFTERBUL  
command = KUMAE4ND  
common = KAA4MUN  
company = KAHM4PUNIY  
complain = KUMPLEY4N  
complex = KUMPLEH4KS  
component = KAHMPOH4NUNT  
computer = KUMPYUW4TER  
condition = KUNDIH4SHUN  
conscience = KAA4NSHUNTS  
console = KAA4NSOHL  
control = KUNTROH4L  
conversation = KAA5NVERSEY4SHUN  
coordinate = KOHWOH4DUNIXT  
corporation = KOH5RPEREY4SHUN  
correction = KOHREH4KSHUN  
count = KAW4NT  
country = KAH4NTRIY  
cousin = KAH4ZIXN  
create = KRIYEY4T  
critical = KRIH4TIXKUL  
culture = KAH4LCHER  
curious = KYUH4RIYAXS

- D -

danger = DEY4NJR  
data = DEY4TAH  
decay = DIXKEY4

decide = DIXSAY4D  
decibel = DEH4SIXBUL  
decrease = DIYKRIY4S  
definition = DEH5FUNIH4SHUN  
degree = DIXGRIY4  
delay = DIXLEY4  
demonstrate = DEH4MUNSTREYT  
department = DIYPAA4RTMIXNT  
desire = DIXZAY4ER  
develop = DIXVEH4LAHP  
dictionary = DIH4KSHUNEHRIY  
different = DIH4FRIXNT  
discount = DIH4SKAWNT  
distance = DIH4STIXNS  
distribution = DIH5STRAXBYUW4SHUN  
division = DIXVIH4ZHUN  
doctor = DAA4KTER  
double = DAH4BUL  
down = DAW4N  
drive = DRAY4V  
dungeon = DAH4NJUN

- F -

face = FEY4S  
fail = FEY4L  
Fahrenheit = FEH4RIXN/HAYT  
false = FAO4LS  
family = FAE4MULIY  
fast = FAE4ST  
fatal = FEY4TUL  
father = FAA4DHER  
fault = FAO4LT  
female = FIY4MEYL  
fight = FAY4T  
figure = FIH4GYER  
file = FAY4L  
filter = FIH4LTER6  
finance = FAY4NAENS  
find = FAY4ND  
finger = FIH4NXGER  
finish = FIH4NIXSH  
fire = FAY4ER  
first = FER4ST  
flavor = FLEY4VER  
flight = FLAY4T  
flow chart = FLOW4CHAART  
flower = FLAW4ER  
fluorescent = FLUHREH4SIXNT  
focus = FOW4KAXS  
follow = FAA4LOW  
foot = FUH5T  
force = FOH4RS  
formula = FOH4RMYUXLAH  
forward = FOH4RWERD  
fraction = FRAE4KSHUN  
fragile = FRAE4JUL  
freedom = FRIY4DUM  
frequency = FRIY4KWUNSIY  
from = FRAH4M  
fuel = FYUW4L  
full = FUH4L  
function = FAH4NXKSHUN  
fundamental = FAH5NDUMEH4NTUL  
fuse = FYUW4Z  
fusion = FYUWSZHUN  
future = FYUW4CHER

- G -

earth = ER4TH  
easy = IY4ZIY  
economics = IY5KUNAA4MIXKS  
education = EH5JUWKEY4SHUN  
either = IY4DHER  
eject = IXJEH4KT  
electricity = ULEHKTRIH4SIXTIY  
electronic = ULEHKTRAA4NIXK  
elementary = EH4LUMEH4NTRIY  
emphasis = EH4MFAXSIHS  
encyclopedia = EHNSAY5KLAXPIY4DIYAH  
energy = EH4NERJYI  
engineering = EH5NJUNIY4RIHNX  
enter = EH4NTER  
enunciate = IYNAH4NSIYEYT  
equal = IY4KWUL  
erase = IXREY4S  
error = EH4ROHR  
escape = EHSKEY4P  
estimate = EH4STUMIXT  
Europe = YUH4RAXP  
evil = IY4VUL  
exciting = EHKSAY4TIHNX  
explain = EHKSPLEY4N  
expression = EHKSPREH4SHUN  
extra = EH4KSTRAH

gain = GEY4N  
galaxy = GAE4LAXKSIY  
game = GEY4M  
garbage = GAA4RBIXJ

gasoline = GAE4SULIYN  
gate = GEY4T  
general = JEH4NERUL  
generate = JEH4NEREYT  
genius = JIY4NYAXS  
gentle = JEH4NTUL  
genuine = JEH4NUYXIXN  
geometry = JIYAA4MIXTRIY  
get = GEH4T  
giant = JAY4IXNT  
gift = GIH4FT  
glass = GLAE4S  
gnome = NOW4M  
go = GOW4  
gold = GOH4LD  
good = GUH4D  
gourmet = GUHRMEY4  
government = GAH4VERNMEHNT  
grand = GRAE4ND  
graphic = GRAE4FIXK  
gravity = GRAE4VIXTIY  
ground = GRAW4ND  
guarantee = GAE4RIXNTIY4  
guide = GAY4D  
gun = GAH4N  
gyroscope = JAY4RAXSKOWP

- H -

habit = /HAE4BIXT  
hacker = /HAE4KER  
hair = /HEH4R  
half = /HAE4F  
hallucination = /HULUW4SIXNEY5SHUN  
hand = /HAE4ND  
happy = /HAE4PIY  
hardware = /HAA4RDWEHR  
harmony = /HAA4RMUNIY  
have = /HAE4V  
head = /HEH4D  
heart = /HAA4RT  
helicopter = /HEH4LIXKAAPTER  
hello = /HEH4LOW  
here/ = HIY4R  
hero = /HIY4ROW  
hertha = /HER4TS  
hesitate = /HEH4ZIXTEY6T  
hexadecimal = /HEH5KSIXDEH4SUMUL  
high = /HAY4  
history = /HIH4STERIY  
hobby = /HAA4BIY  
hold = /HOW4LD

home = /HOW4M  
honest = AA4NIXST  
horoscope = /HOH4RAXSKOWP  
hospital = /HAA4SPIXTUL  
hour = AW4ER  
house = /HAW4S  
however = /HAWEH4VER  
huge = /HYUW4J  
human = /HYUW4MUN  
humor = /HUYW4MER  
husband = /HAH4ZBUND  
hyper = /HAY4PER  
hypothesis = /HAYPAA4THAXSIHS

- I -

I = AY4  
ice = AY4S  
idea = AYDIY4AX  
identical = AYDEH4NTIXKUL  
identity = AYDEH4NTIXTIY  
illusion = IHLUX4ZHUN  
image = IH4MIXJ  
imagination = IHMAE4JIXNEY5SHUN  
immobilize = IXMOH4BULAYZ  
important = IHMPOH4RTUNT  
in = IH4N  
inch = IHN4CH  
included = IHNKLUX4DIXD  
income = IH4NKUM  
inconvenient = IHN5KUNVIY4NYUNT  
increase = IHNKRIY4S  
indeed = IHNDIY4D  
index = IH4NDEHK  
indicate = IH4NDIXKEYT  
indirect = IH5NDEREH4KT  
individual = IH5NDIXVIH4JUWUL  
industry = IH4NDAHSTRIY  
inferior = IHNFIH4RIYER  
inflation = IHNFLEY4SHUN  
influence = IH4NFLUWIXNS  
information = IH5NFERMEY4SHUN  
-ing = IHNX  
inject = IHNJEH4KT  
injure = IH4NJR  
initial = IXNIH4SHUL  
inside = IHNSAY4D  
inspect = IHNSPEH4KT  
insulator = IH4NSULEYTER  
integer = IH4NTIXJER  
intelligent = IHNTEH4LIXJIXNT  
interest = IH4NTREHST

interference = IH4NTERFIY4RIXNS  
intermittent = IH4NTERMIH4TNNT  
invader = IHNVEY4DER  
invent = IHNVEH4NT  
inverse = IH4NVERS  
involve = IHNVAAC4LV  
iron = AY4ERN  
irrational = IHRAE4SHUNUL  
isolate = AY4SULEYT  
issue = IH4SHUW  
item = AY4TUM

- J -

jacket = JAE4KIXT  
jam = JAE4M  
jargon = JAA4RGUN  
jazz = JAE4Z  
jiffy = JIH4FIY  
job = JAA4B  
join = JOY4N  
joke = JOW4K  
judge = JAH4J  
jump = JAH4MP  
junction = JAH4NXKSHUN  
junior = JUW4NYER  
just = JAH4ST  
jail = JEY4L  
jewelry = JUW4LRIY  
journey = JER4NIY  
jungle = JAH4NXGUL  
junk = JAH4NXK

- K -

keep = KIY4P  
key = KIY4  
keyboard = KIY4BOHRD  
kilobyte = KIH4LAXBAYT  
kind = KAY4ND  
kingdom = KIH4NXGDM  
knight = NAY4T  
knowledge = NAA4LIXJ

- L -

label = LEY4BUL  
lady = LEY4DIY  
language = LAE4NXGWIXJ  
large = LAA4RJ  
laser = LEY4ZER  
last = LAE4ST

late = LEY4T  
laugh = LAE4F  
launch = LAO4NCH  
law = LAO4  
layer = LEY4ER  
lead = LIY4D  
lease = LIY4S  
lecture = LEH4KCHER  
left = LEH4FT  
legal = LIY4GUL  
legend = LEH4JIXND  
leisure = LIY4ZHER  
length = LEH4NTH  
letter = LEH4TER  
level = LEH4VUL  
liberal = LIH4BERUL  
life = LAY4F  
lift = LIH4FT  
light = LAY4T  
like = LAY4K  
limit = LIH4MIXT  
linear = LIH4NIYER  
liquid = LIH4KWIXD  
list = LIH4ST  
listen = LIH4SIXN  
literature = LIH4TERIXCHER  
little = LIH4TUL  
load = LOW4D  
local = LOW4KUL  
location = LOWKEY4SHUN  
lock = LAA4K  
logarithm = LAO4GERIH5DHUM  
logical = LAA4JHKUL  
long = LAO4NX  
look = LUH4K  
loop = LUW4P  
lose = LOW4Z  
love = LAH4V  
low = LOW4  
loyal = LOY4UL  
luminescence = LUW4MIXNEH5SIXNS  
lunatic = LUW4NAXTIH6K  
luxury = LAH4GZHERIY

- M -

machine = MAXSHIY4N  
madam = MAE4DUM  
made = MEY4D  
magazine = MAEGAXZIY4N  
magic = MAE4JHK  
magnet = MAE4GNIXT

magnitude = MAE4GNIHTUX5D  
mail = MEY4L  
main = MEY4N  
major = MEY4JER  
make = MEY4K  
malfunction = MAE5LFAH4NXKSHUN  
man = MAE4N  
manager = MAE4NIXJER  
maneuver = MUNUW4VER  
manipulate = MUNIH4PYUHLEYT  
manual = MAE4NYUWUL  
manufacture = MAE5NUYXFAE4KCHER  
many = MEH4NIY  
marginal = MAA4RJIXNUL  
market = MAA4RKIXT  
marriage = MEH4RIXJ  
mass = MAE4S  
master = MAE4STER  
mate = MEY4T  
material = MAXTIH4RIYUL  
mathematics = MAE4THUMAE5TIXKS  
mature = MAXCHUX4R  
maximum = MAE4KSIXMUM  
may = MEY4  
meaning = MUY4NIHNX  
measure = MEH4ZHER  
mechanical = MIXKAE4NIHKUL  
mechanism = MEH4KUNIHZUM  
media = MIY4DIYAH  
medical = MEH4DIXKUL  
medium = MIY4DIYUM  
member = MEH4MBER  
memory = MEH4MERIY  
mental = MEH4NTUL  
menu = MEH4NYUW  
merchandise = MER4CHUNDAY5S  
merge = MER4J  
metal = MEH4TUL  
meter = MIY4TER  
method = MEH4THIXD  
micro = MAY4KROW6  
middle = MIH4DUL  
might = MAY4T  
mile = MAY4L  
military = MIH4LIXTEH6RIY  
million = MIH4LYUN  
mind = MAY4ND  
mineral = MIH4NERUL  
miniature = MIH4NIYAXCHER  
minimum = MIH4NIXMUM  
minus = MAY4NIXS  
miracle = MIH4RIXKUL

miscellaneous = MIH5SULEY4NIYAXS  
missile = MIH4SUL  
mister = MIH4STER  
mixture = MIH4KSCHER  
mnemonic = NIXMAA4NIXK  
model = MAA4DUL  
modulation = MAA4JULEY5SHUN  
molecule = MAA4LIXKYUWL  
moment = MOH4MIXNT  
money = MAH4NIY  
monitor = MAA4NIXTER  
monolithic = MAANULIH4THIXK  
monotone = MAA4NAXTOW6N  
month = MAH4NTH  
moon = MUW4N  
morning = MOH4RNINHX  
most = MOW4ST  
mother = MAH4DHER  
motion = MOW4SHUN  
motor = MOW4TER  
mouth = MAW4TH  
move = MUW4V  
much = MAH4CH  
multiply = MAH4LTIX6PLAY  
murder = MER4DER  
muscle = MAH4SUL  
music = MYUW4ZIXK  
must = MAH4ST  
my = MAY4  
myself = MAYSEH4LF  
mystery = MIH4STERIY

- N -

naive = NAY5IY4V  
name = NEY4M  
narrate = NAE4REYT  
narrow = NAE4ROW  
natural = NAE4CHERUL  
nature = NEY4CHER  
navigate = NAE4VIXGEYT  
near = NIY4R  
need = NIY4D  
negative = NEH5GAXTIH6V  
negotiate = NIXGOW4SHIYEYT  
neighborhood = NEY4BER/HUH6D  
nerve = NER4V  
neutral = NUX4TRUL  
news = NUW4Z  
nice = NAY4S  
night = NAY4T  
noise = NOY4Z

nomenclature = NOH4MIXNKLEY6CHER  
none = NAH4N  
normal = NOH4RMUL  
north = NOH4RTH  
nose = NOW4Z  
notation = NOHTEY4SHUN  
notice = NOW4TIKS  
nothing = NAH4THIHNX  
now = NAW4  
nuclear = NUX4KLIYER  
number = NAH4MBER

- O -

object = AA4BJEHKT  
obligation = AA5BLIXGEY4SHUN  
observe = AXBZER4V  
obvious = AA4BVIYAXS  
occational = AHKEY4ZHUNUL  
occupation = AA5KYUXPEY4SHUN  
ocean = OW4SHUN  
odd = AA4D  
of = AH4V  
off = AO4F  
offer = AO4FER  
office = AO4FIXS  
official = AHFIH4SHUL  
ogre = OW4GER  
ohm = OW4M  
oil = OY4L  
O.K. = OW4KEY  
old = OW4LD  
omen = OW4MUN  
on = AA4N  
open = OW4PUN  
operate = AA4PEREYT  
opinion = AHPIH4NYUN  
oppose = AHPOW4Z  
opposite = AA4PAXSIHT  
option = AA4PSHUN  
orbit = OH4RBIHT  
orchestra = OH4RKEHSTRAH  
order = OH4RDER  
ordinary = OH4RDIXNEHRIY  
organize = OH4GUNAYZ  
origin = OH4RIXJIXN  
oscillation = AA5SULEY4SHUN  
other = AH4DHER  
ought = AO4T  
out = AW4T  
outlet = AW4TLEHT  
output = AW4TPUHT

outside = AWTSAY4D  
over = OW4VER  
own = OW4N  
oxygen = AA4KSAXJIXN

- P -

pack = PAEPAE4K  
package = PAE4KIXJ  
page = PEY4J  
paint = PEY4NT  
pair = PEH4R  
palace = PAE4LIXS  
panel = PAE4NUL  
paper = PEY4PER  
parabola = PERAE4BULAH  
paradox = PAE4RAXDAA6KS  
parallel = PAE4RULEH6L  
paragraph = PAE4RAXGRAEF  
pardon = PAA4RDUN  
parent = PEH4RUNT  
parity = PAE4RIXTIY  
park = PAA4RK  
part = PAA4RT  
particle = PAA4RTIXKUL  
particular = PAARTIH4KYUHLER  
pass = PAE4S  
patch = PAE4TCH  
pathetic = PAHTHEH4TIXK  
pattern = PAE4TERN  
pause = PAO4Z  
pay = PEY4  
payroll = PEY4ROW6L  
peculiar = PIXKYUW4LYER  
penalty = PEH4NULTIY4  
penetrate = PEH4NAXTREY6T  
perception = PERSEH4PSHUN  
perfect = PER4FIKXT  
period = PIH4RIYIXD  
permanent = PER4MUNIXNT  
permission = PERMIH4SHUN  
person = PER4SUN  
personality = PER4SUNAE5LIXTIY  
perspective = PERSPEH4KTIKV  
pet = PEH4T  
phantom = FAE4NTUM  
phase = FEY4Z  
phenomenon = FUNAA4MIXNUN  
philosophy = FULAA4SAHFIY  
phoneme = FOW4NIYM  
photo = FOW4TOW  
physical = FIH4ZIXKUL

physics = FIH4ZIXKS  
piano = PYAE4NOW  
pick = PIH4K  
picture = PIH4KCHER  
pilot = PAY4LIXT  
pin = PIH4N  
pirate = PAY4RIXT  
pistol = PIH4STUL  
pitch = PIH4TCH  
pity = PIH4TIY  
place = PLEY4S  
plan = PLAE4N  
planet = PLAE4NIXT  
plastic = PLAE4STIXK  
plausible = PLAO4ZAXBUL  
play = PLEY4  
please = PLIY4Z  
pleasure = PLEH4ZHER  
plectrum = PLEH4KTRUM  
plenty = PLEH4NTIY  
plot = PLAA4T  
plug = PLAH4G  
plus = PLAH4S  
poetry = POW4IXTRIY  
point = POY4NT  
poke = POW4K  
police = PULIY4S  
policy = PAA4LIXSIY  
polynomial = PAA5LIXNOH4MIYUL  
pop = PAA4P  
popular = PAA4PYULER  
population = PAA4PYULEY4SHUN  
port = POH4RT  
portable = POH4RTAXBUL  
positive = PAA4ZIXTIX6V  
position = PAXZIH4SHUN  
power = PAW4ER  
practice = PRAE4KTIHS  
precise = PRIXSAY4S  
prefer = PRIXFER4  
prelimianry = PREIXLIH4MIXNEHRIY  
prepare = PRIXEPEH4R  
present = PREH4ZIXNT  
press = PREH4S  
pressure = PREH4SHER  
prevent = PRIXEVEH4NT  
primary = PRAY4MEHRIY  
primitive = PRIH4MIXTIX6V  
prince = PRIH4NS  
princess = PRIH4NSEHS  
print = PRIH4NT  
private = PRAY4VIXT

probably = PRAA4BAXBLIY  
problem = PRAA4BLUM  
proceed = PROHSIY4D  
process = PRAA4SEHS  
produce = PRAXDUW4S  
professional = PRAXFEH4SHUNUL  
professor = PRAHFEH4SER  
profit = PRAA4FIXT  
program = PROW4GRAEM  
project = PRAA4JEHKT  
promise = PRAA4MIHS  
pronounce = PRUNAW4NS  
proper = PRAA4PER  
proportional = PRAXPOH4RSHUNUL  
protect = PRAXTEH4KT  
proud = PRAW4D  
psychiatrist = SAYKAY4AXTRIX6ST  
public = PAH4BLIXK  
publish = PAH4BLIHS  
pull = PUH4L  
pulse = PAH4LS  
pure = PYUW4R  
push = PUH4SH  
put = PUH4T

- Q -

quality = KWAA4LIXTIY  
quantity = KWAA4NTIXTIY  
question = KWEH4SCHUN  
quick = KWIH4K  
quiet = KWAY4IXT  
quit = KWIH4T  
quiz = KWIH4Z  
quote = KWOW4T  
quotient = KWOW4SHUNT

- R -

race = REY4S  
radar = REY4DAAR  
radiation = REY5DIYEY4SHUN  
radio = REY4DIYOW  
radius = REY4DIYAH  
rain = REY4N  
random = RAE4NDUM  
range = REY4N  
rare = REH4R  
rate = REY4T  
rather = RAE4DHER  
ratio = REY4SHIYOW  
reach = RIY4CH

reaction = RIYAE4KSHUN  
read = RIY4D  
realistic = RIY5LIH4STIXK  
reason = RIY4ZUN  
receive = RIXSIY4V  
reciter = RIXSAY4TER  
recognize = REH4KAXGNAYZ  
recommend = REH5KUMEH4ND  
record = REH4KERD  
recover = RIYKAH4VER  
rectangle = REH4KTAENXGUL  
reduce = RIXDUW4S  
refer = RIYFER4  
reference = REH4FERIXNS  
reflection = RIXFLEH4KSHUN  
refrigerator = RIXFRIH4JEREYTER  
region = RIY4JUN  
register = REH4JIXSTER  
regular = REH4GYUXLER  
reject = RIXJEH4KT  
relativity = REH5LAXTIH4VIXTIY  
relax = RIXLAE4KS  
relay = RIY4LEY  
release = RIXLIY4S  
relief = RIYLIY4F  
religion = RIXLUH4JUN  
remain = RIYMEY4N  
remember = RIXMEH4MBER  
remove = RIYMUX4V  
rent = REH4NT  
repeat = RIXPIY4T  
replace = RIXPLEY4S  
reply = RIXPLAY4  
report = RIXPOH4RT  
represent = REHPRIXZEH4NT  
reproduction = RIY5PRAXDAH4KSHUN  
republic = RIXPAH4BLIXK  
rescue = REH4SKYUW  
research = RIY4SERCH  
reserve = RIXZER4V  
resistance = RIXZIH4STUNS  
respect = RIXSPEH4KT  
response = RIXSPAA4NS  
rest = REH4ST  
restore = RIXSTOH4R  
retail = RIY4TEY6L  
return = RIXTER4N  
reverse = RIXVER4S  
review = RIXVYUW4  
revolution = REH5VULUXWSHUN  
rhapsody = RAE4PSAXDIY  
rhythm = RIH4DHUM

rich = RIH4CH  
ride = RAY4D  
ridiculous = RIXDIH4KYULAXS  
right = RAY4T  
rigid = RIH4JIXD  
ring = RIH4NX  
rise = RAY4Z  
river = RIH4VER  
road = ROW4D  
rocket = RAA4KIXT  
roll = ROH4L  
room = RUW4M  
rough = RAH4F  
round = RAW4ND  
rubber = RAH4BER  
rule = RUW4L  
run = RAH4N  
rush = RAH4SH

- S -

sabotage = SAE5BAXTAA6ZH  
sacrifice = SAE4KRIXFAYS  
sad = SAE4D  
safe = SEY4F  
safety = SEY4FTIY  
saint = SEY4NT  
sale = SEY4L  
S.A.M. = SAE4M  
same = SEY4M  
sample = SAE4MPUL  
sanctuary = SAE4NXKCHUWEH6RIY  
sandwich = SAE4NWIXCH  
sarcasm = SAA4RKAEZUM  
satisfaction = SAE4TIXSFAE4KSHUN  
savage = SAE4VIXJ  
save = SEY4V  
say = SEY4  
scale = SKEY4L  
scandal = SKAE4NDUL  
scarce = SKEY4RS  
scatter = SKAE4TER  
scenic = SIY4NIXK  
schedule = SKEH4JYUWL  
scheme = SKIY4M  
scholar = SKAA4LER  
school = SKUW4L  
science = SAY4IHNS  
scientific = SAY4UNTIH5FIXK  
scientific = SAY4AXNTIH5FIXK  
scissors = SIH4ZERZ  
score = SKOH4R

scramble = SKRAE4MBUL  
scratch = SKRAE4CH  
scream = SKRIY4M  
screw = SKRUW4  
script = SKRIH4PT  
scroll = SKROW4L  
seal = SIY4L  
search = SER4CH  
season = SIY4ZUN  
second = SEH4KUND  
secret = SIY4KRIXT  
secretary = SEH4KRIXTEH5RIY  
section = SEH4KSHUN  
security = SIXKYUH4RIXTIY  
see = SIY4  
seek = SIY4K  
segment = SEH4GMIXNT  
self = SEH4LF  
sell = SEH4L  
semi- = SEH4MIY  
send = SEH4ND  
sensation = SEHNSEY4SHUN  
senior = SIY4NYER  
sense = SEH4NS  
sensible = SEH4NSIXBUL  
sensitive = SEH4NSIXTIX6V  
sentence = SEH4NTIXNS  
separate = SEH4PERIXT  
sequence = SIY4KWEHNS  
serial = SIH4RIYUL  
serious = SIH4RIYAH5  
serve = SER4V  
service = SER4VIXS  
session = SEH4SHUN  
set = SEH4T  
settle = SEH4TUL  
several = SEH4VERUL  
sex = SEH4KS  
shadow = SHAE4DOW  
shake = SHEY4K  
shame = SHEY4M  
shape = SHEY4P  
share = SHEY4R  
sharp = SHA4RP  
she = SHIY4  
sheet = SHIY4T  
shield = SHIY4LD  
shift = SHIH4FT  
shock = SHA4K  
shoot = SHUW4T  
shop = SHA4P  
short = SHOH4RT  
should = SHUH4D  
show = SHOW4  
shy = SHAY4  
sick = SIH4K  
side = SAY4D  
sight = SAY4T  
sign = SAY4N  
signal = SIH4GNUL  
silent = SAY4LIXNT  
silver = SIH4LVER  
similar = SIH4MULER  
simple = SIH4MPUL  
simplicity = SIHMPLI4SIXTIY  
simulator = SIH4MYULEYTER  
sin = SIH4N  
single = SIH4NXGUL  
sinister = SIH4NIXSTER  
sir = SER4  
siren = SAY4RIXN  
sit = SIH4T  
situation = SIH5CHUWEY4SHUN  
skeptical = SKEH4PTIXKUL  
sketch = SKEH4TCH  
skill = SKIH4L  
skip = SKIH4P  
slang = SLAE4NX  
sleep = SLIY4P  
sleeve = SLIY4V  
slip = SLI4P  
slot = SLAA4T  
slow = SLOW4  
small = SMAO4L  
smart = SMAA4RT  
smell = SMEH4L  
smooth = SMUW4DH  
snap = SNAE4P  
so = SOW4  
social = SOW4SHUL  
society = SAXSAY4IXTIY  
soft = SAO4FT  
solar = SOW4LER  
soldier = SOH4LJER  
solemn = SAA4LUM  
solid = SAA4LIXD  
solitude = SAA4LIXTUW6D  
solution = SULUW4SHUN  
some = SAH4M  
somebody = SAH4MBAADIY  
song = SAO4NX  
soon = SUW4N  
sophisticated = SAXFIH4STIXKEYTIXD  
sorry = SAA4RIY

sort = SOH4RT  
sound = SAW4ND  
south = SAW4TH  
space = SPEY4S  
spare = SPEY4R  
spatial = SPEY4SHUL  
speak = SPIY4K  
special = SPEH4SHUL  
specific = SPAXSIH4FIXK  
speculate = SPEH4KYULEYT  
speech = SPIY4CH  
speed = SPIY4D  
spell = SPEH4L  
spend = SPEH4ND  
sphere = SFIY4R  
spin = SPIH4N  
spiral = SPAY4RUL  
spirit = SPIH4RIFT  
splendid = SPLEH4NDIXD  
split = SPLIH4T  
spoil = SPOY4L  
spontaneous = SPAANTEY4NIYAH  
sports = SPOH4RTS  
spot = SPA4AT  
spread = SPREH4D  
spring = SPRIH4NX  
spy = SPAY4  
square = SKWEH4R  
squeeze = SKWIY4Z  
stability = STAXBIH4LIXTIY  
staff = STAE4F  
stand = STAE4ND  
standard = STAE4NDERD  
star = STA4R  
start = STAA4RT  
state = STEY4T  
static = STAE4TIXK  
station = STEY4SHUN  
stay = STEY4  
steady = STEH4DIY  
steer = STIY4R  
step = STEH4P  
stereo = STEH4RIYOW  
stick = STIH4K  
stimualte = STIH4MYULEYT  
stock = STAA4K  
stone = STOW4N  
stop = STAA4P  
store = STOH4R  
story = STOH4RIY  
straight = STREY4T  
strange = STREY4NJ

strategy = STRAE4TIXJIY  
street = STRIY4T  
strength = STREY4NTH  
strike = STRAY4K  
strong = STRAO4NX  
structure = STRAH4KCHER  
stubborn = STAH4BERN  
student = STUW4DIXNT  
study = STA4DIY  
stuff = STA4F  
stupid = STUX4PIXD  
style = STAY4L  
subject = SAH4BJEHKT  
substance = SAH4BSTIXNS  
subtle = SAH4TUL  
succession = SAHKSEH4SHUN  
succeed = SAHKS4YD  
such = SAH4CH  
sudden = SAH4DIXN  
suggest = SAHGJEH4ST  
sum = SAH4M  
summer = SAH4MER  
sun = SAH4N  
super = SUX4PER  
superb = SUXPER4B  
superior = SUXPIH4RIYER  
supply = SAXPLAY4  
support = SAXPOH4RT  
sure = SHUX4R  
surprise = SERPRAY4Z  
surroundings = SERAW4NDIHNXGZ  
suspend = SAHSP4H4ND  
swear = SWEH4R  
sweep = SWIY4P  
swell = SWEH4L  
swing = SWIH4NX  
syllable = SIH4LAXBUL  
symbol = SIH4MBUL  
symbolic = SIHMBAA4LIXK  
symmetric = SIHMEH4TRIXK  
sympathy = SIH4MPAXTHIY  
synchronize = SIH4NXKRAX5NAYZ  
synonym = SIH4NUNIXM  
system = SIH4STUM  
synthesizer = SIH4NTHAXSAYZER

- T -

tab = TAE4B  
table = TEY4BUL  
tactical = TAE4KTIXKUL  
tail = TEY4L

take = TEY4K  
talent = TAE4LIX6NT  
tall = TAO4L  
talk = TAO4K  
tap = TAE4P  
tape = TEY4P  
target = TAA4RGIXT  
task = TEY4ST  
tax = TAE4KS  
teach = TIY4CH  
team = TIY4M  
technical = TEH4KNIXKUL  
technology = TEHKNAA4LAXJIY  
telephone = TEH4LAX6FOWN  
television = TEH4LAX6VIXZHUN  
temper = TEH4MPER  
tender = TEH4NDER  
tense = TEH4NS  
tension = TEH4NSHUN  
term = TER4M  
terminal = TER4MIXNUL  
terrestrial = TER6EH4STRY6UL  
terrible = TEH4RAXBUL  
territory = TEH4RAXTOH6RIY  
terror = TEH4RER6  
test = TEH4ST  
testimony = TEH4STUMOHNIIY  
text = TEH4KST  
than = DHAE4N  
than = DHAE4N  
thank = THAE4NXK  
that = DHAE4T  
the = DHAH4  
theater = THIY4AHTER  
then = DHEH4N  
theorem = THIY4RUM  
theory = THIY4RIY  
thermometer = THERMAA4MIXTER  
thesis = THIY4SIXS  
they = DHEY4  
thin = THIH4N  
thing = THIH4NX  
think = THIH4NXK  
this = DHIH4S  
thought = THAO4T  
threshold = THREH4SH/HOWLD  
through = THRUW4  
ticket = TIH4KIXT  
tight = TAY4T  
time = TAY4M  
tiny = TAY4NIY  
tired = TAY4ERD

title = TAY4TUL  
together = TUXGEH4DHER  
tolerance = TAA4LERIXNS  
tone = TOW4N  
tool = TUW4L  
top = TAA4P  
toss = TAO4S  
touch = TAH4CH  
tough = TAH4F  
tournament = TER4NUMIXNT  
toward = TOH4RD  
toward = TOW4RD  
town = TAW4N  
toy = TOY4  
trace = TREY4S  
track = TRAE4K  
trade = TREY4D  
tradition = TRAXDIH4SHUN  
traffic = TRAE4FIXK  
trail = TREY4L  
trajectory = TRAXJEH4KTERY  
transaction = TRAENZAE4KSHUN  
transfer = TRAE4NSFER  
transform = TRAENSFOH4RM  
transistor = TRAENZIH4STER  
translate = TRAE4NZLEYT  
transmit = TRAE4NZMIXT  
transparent = TRAE5NSPEH4RIXNT  
transportation = TRAE5NZPOHRTEY4SHUN  
trap = TRAE4P  
treasury = TREH4ZHERIY  
tree = TRIY4  
trek = TREH4K  
tremendous = TRIXMEH4NDAXS  
trespass = TREH4SPAES  
trial = TRAY4UL  
triangle = TRAY4AENXGUL  
trick = TRIH4K  
trigger = TRIH4GER  
trim = TRIH4M  
trip = TRIH4P  
triple = TRIH4PUL  
triumph = TRAY4AHMF  
troll = TROW4L  
trophy = TROW4FIY  
trouble = TRAH4BUL  
truck = TRAH4K  
true = TRUW4  
truth = TRUW4TH  
try = TRAY4  
tune = TUW4N  
tunnel = TAH4NUL

turn = TER4N  
tutor = TUW4TER  
twist = TWIH4ST  
type = TAY4P  
typewriter = TAY4PRAYTER

- U -

ugly = AH4GLIY  
ultimate = AH4LTAX6MIXT  
uncle = AH4NKUL  
under = AH4NDER  
understand = AH5NDERSTAE4ND  
uniform = YUW4NIXFOHRM  
union = YUW4NYUN  
unit = YUW4NIXT  
universal = YUW5NIXVER4SUL  
unless = AHNLEH4S  
up = AH4P  
upset = AHPSEH4T  
urge = EH4RJ  
use = YUW4S  
utility = YUWTIH4LIXTIY

- V -

vacation = VEYKEY4SHUN  
vacuum = VAE4KYUWM  
vague = VEY4G  
valid = VAE4LIXD  
value = VAE4LYUW  
valve = VAE4LV  
vanadium = VUNEY4DIYUM  
vapor = VEY4PER  
variation = VEH5RIYEY4SHUN  
various = VEH4RIYAH  
vary = VEH4RIY  
veal = VIY4L  
vector = VEH4KTER  
vegetable = VEH4JTAXBUL  
vehicle = VIY4IX6KUL  
ventilate = VEH4NTULEYT  
verb = VER4B  
versatile = VER4SAXTUL  
verse = VER4S  
version = VER4ZHUN  
vertical = VER4TIXKUL  
very = VEH4RIY  
veto = VIY4TOW  
vibration = VAYBREY4SHUN  
vicinity = VAXSIH4NIXTIY  
victory = VIH4KTERIY

video = VIH4DIYOW  
village = VIH4LIXJ  
vinyl = VAY4NUL  
violation = VAY4AXLEY5SHUN  
virtue = VER4CHUW  
visible = VIH4ZIXBUL  
visit = VIH4ZIXT  
vital = VAY4TUL  
vocabulary = VOHKAE4BYULEHRIY  
vocal = VOW4KUL  
voice = VOY4S  
volt = VOW4LT  
volume = VAA4LYUWM  
voluntary = VAA4LUNTEH5RIY  
vote = VOW4T  
vowel = VAW4UL  
voyage = VOY4IXJ  
video = VIH4DIYOW

- W -

wafer = WEY4FER  
wage = WEY4J  
wait = WEY4T  
wake = WEY4K  
walk = WAO4K  
wall = WAO4L  
war = WOH4R  
warm = WOH4RM  
warp = WOH4RP  
warranty = WOH5RIXNTIY4  
wash = WAA4SH  
waste = WEY4ST  
watch = WAA4CH  
water = WAO4TER  
watt = WAA4T  
wave = WEY4V  
way = WEY4  
weak = WIY4K  
wealth = WEH4LTH  
wear = WEH4R  
wedding = WEH4DIHNX  
week = WIY4K  
weight = WEY4  
welcome = WEH4LKUM  
well = WEH4L  
were = WER4  
what = WHAH4T  
wheel = WHIY4L  
when = WHEH4N

which = WHIH4CH  
while = WHAY4L  
whisper = WHIH4SPER  
white = WHAY4T  
who = /HUW4  
whole = /HOW4L  
wide = WAY4D  
wild = WAY4LD  
will = WIH4L  
win = WIH4N  
window = WIH4NDOW  
wing = WIH4NX  
winter = WIH4NTER  
wise = WAY4Z  
wish = WIH4SH  
with = WIH4TH  
wizard = WIH4ZERD  
woman = WUH4MUN  
women = WIH4MIXN  
wonder = WAH4NDER  
word = WER4D  
Wordrace = WER2D REYS  
work = WER4K  
world = WUH4RLD  
worry = WER4IY  
would = WUH4D  
wrap = RAE4P  
write = RAY4T  
wrong = RAO4NX

**- X -**

Zerox = ZIH4RAAKS  
X-ray = EH4KSREY  
xylophone = ZAY4LAXFOWN

**- Y -**

yacht = YAA4T  
yard = YAA4RD  
yawn = YAO4N  
year = YIH4R  
yellow = YEH4LOW  
yes = YEH4S  
you = YUW4  
your = YOH4R  
youth = YUX4TH

**- Z -**

zany = ZEY4NIY  
zero = ZIY4ROW

zig-zag = ZIH3GZAEG  
zip = ZIH4P  
zodiac = ZOW4DIY6AEK  
zone = ZOW4N

**- DAYS OF THE WEEK -**

Monday = MAH4NDEY  
Tuesday = TUW4ZDEY  
Wednesday = WEH4NZDEY  
Thursday = THER4ZDEY  
Friday = FRAY4DEY  
Saturday = SAE4TERDEY  
Sunday = SAH4NDEY

**- MONTHS OF THE YEAR -**

January = JAE4NYUXEHRIY  
February = FEH4BRUXEH6RIY  
March = MAA4RCH  
April = EY4PRIXL  
May = MEY4  
June = JUW4N  
July = JUHLAY4  
August = AO4GAXST  
September = SEHPTEH4MBER  
October = AAKTOW4BER  
November = NOHVEH4MBER  
December = DIHSEH4MBER

**- NUMBERS -**

one = WAH4N  
two = TUW4  
three = THRIY4  
four = FOH4R  
five = FAY4V  
six = SIH4KS  
seven = SEH4VIXN  
eight = EY4T  
nine = NAY4N  
ten = TEH4N  
eleven = IXLEH4VIXN  
twelve = TWEH4LV  
thirteen = THER4TIY6N  
twenty = TWEH4NTIY  
thirty = THER4TIY  
hundred = /HAH4NDRIXD  
thousand = THAW4ZUND  
million = MIH4LYUN

## - STATES AND PROVINCES -

United States = YUWNAY4TIXD STEY4TS  
Alabama = AE4LAXBAE6MAX  
Alaska = AHLAE4SKAH  
Arizona = EH4RAXZOW5NAH  
Arkansas = AA4RKUNSAO  
California = KAE5LAXFOH4RNYAH  
Colorado = KAA5LAXRAA4DOW  
Connecticut = KAHNEH4TIXKAHT  
Delaware = DEH4LAXWEH6R  
Florida = FLOH4RIXDAH  
Georgia = JOH4RJAH  
Hawaii = /HAHWAY4IY  
Idaho = AY4DAH/HOW  
Illinois = IHLUNOY4  
Indiana = IH5NDIYAE4NAH  
Iowa = AY4AHWAH  
Kansas = KAE4NZIXS  
Kentucky = KEHNTAH4KIY  
Louisiana = LUXIY4ZIYAE5NAH  
Maine = MEY4N  
Maryland = MEH4RULIXND  
Massachusetts = MAE5SAXCHUW4SIXTS  
Michigan = MIH4SAXGUN  
Minnesota = MIH5NAXSOW4TAH  
Mississippi = MIH5SIXSIH4PIY  
Missouri = MIHZUH4RIY  
Montana = MAANTAE4NAH  
Nebraska = NAXBRAE4SKAH  
Nevada = NAXVAE4DAH  
New Hampshire = NUW6/HAE4MPSHER  
New Jersey = NUWJER4ZIY  
New Mexico = NUWMEH4KSIXKOW  
New York = NUWYOH4RK  
North Carolina = NOH4RTH  
KEH5RULAY4NAH  
North Dakota = NOH4RTH DAHKOW4TAH  
Ohio = OW/HAY4OW  
Oklahoma = OWKLAX6/HOW4MAH  
Oregon = OH4RIXGUN  
Pennsylvania = PEH5NSULVEY4NYAH  
Rhode Island = ROW5D AY4LUND  
South Carolina = SAW4TH  
KEH5RULAY4NAH  
South Dakota = SAW4TH DAXKOW4TAH  
Tennessee = TEH5NAXSIY4  
Texas = TEH4KSAXS  
Utah = YUW4TAO6  
Vermont = VERMAA4NT  
Virginia = VERJIH4NYAH  
Washington = WAA4SHIHNXTAHN

West Virginia = WEH5ST VERJIH4NYAH  
Wisconsin = WIHSKAA4NSUN  
Wyoming = WAYOW4MIHNX

Provinces of Canada =  
PRAA4VIXNSIXZ AHV KAE4NAXDAH

Alberta = AELBER4TAH  
British Columbia =  
BRIH4TIXSH KAHLAH4MBIYAH  
Manitoba = MAE5NIXTOW4BAH  
New Brunswick = NUWBRAH4NZWIXK  
Newfoundland = NUW4FIXNLIXND  
Nova Scotia = NOH4VAXSKOW4SHAH  
Ontario = AANTEH4RIYOW  
Prince Edward Island =  
PRIH5NS EH4DWERD AY4LUND  
Quebec = KUHBEH4K  
Saskatchewan = SAESKAE4CHAXWAAN

## - UNITS -

units = YUW4NIXTS  
inches = IH4NCHIXZ  
feet = FIY4T  
yards = YAA4RDZ  
miles = MAY4LZ  
centimeters = SEH4NTIXMIY6TERZ  
kilometers = KIXLAA4MIXTERZ  
acres = EY4KERZ  
ounces = AW4NSIXZ  
pounds = PAW4NDZ  
tons = TAH4NZ  
grams = GRAE4MZ  
teaspoons = TIY4SPUWNZ  
cups = KAH4PS  
pints = PAY4NTS  
quarts = KWOH4RTS  
gallons = GAE4LUNZ  
liters = LIY4TERZ  
degrees = DAXGRIY4Z

## FINDING PHONEME SPELLING ERRORS

If you have made a phonetic spelling mistake that causes S.A.M. to be unable to break your string down into phonemes, he will beep twice at you and come back to BASIC without speaking. The location of the bad letter in the string is stored for you to examine. Also, you may PEEK at this location in a program to see if there were any errors in spelling and then make the required changes.

Here is a sample error-checking and display program:

```
100  SAM$ = "MAY VOY4C IHZ BIHZA5R."
110  A = USR( 8192 )
120  IF PEEK( 8211 ) < 255 THEN GOSUB 1000:REM ERROR CHECK

1000 REM ERROR DISPLAY — ERROR APPEARS IN INVERSE
1010 N = PEEK( 8211 ):REM N IS POSITION OF ERROR
1020 SAM$(N,N) = CHR$(ASC(SAM$(N,N))+128)
1030 PRINT SAM$
1040 RETURN
```

The inverse character marks the spot where S.A.M. could no longer continue reading the string.

## TECHNICAL NOTES USE IN BASIC

S.A.M. from BASIC performs all stack housekeeping that is required.

When S.A.M. completes vocal output, the NMIEN (Non-maskable Interrupt Enable) (\$D40E) returns to the following conditions:

BIT 6 — Vertical Blank Interrupt Enable = "on"  
BIT 7 — Display List Instruction Interrupt Enable = "on"

All other registers are returned to OS shadow values within 1/60 second after vocal output.

Note that during speech, the VBI is shut down so that the real-time clock registers (18, 19, 20) do **not** advance.

## SCREEN BLANK

The screen blanks during vocal output because Direct Memory Access (DMA) causes gaps to be inserted into the speech waveform each time the 6502 processor waits for the ANTIC chip to access memory. The audible result is extremely distorted speech when the screen is on.

If this speech quality is desirable for some application (or the screen **must** remain on during speech), S.A.M. may be operated in the DMA-enabled mode by POKE-ing a "1" into the "lights" register: **8210**. There are different speed and pitch addresses to be used in this case. To return to DMA-disabled speech, POKE a "0" into this register.

## IMPORTANT ADDRESSES

	Decimal	Hex
S.A.M. from Atari BASIC	<b>8192</b>	<b>\$2000</b>
S.A.M. from machine language	<b>8196</b>	<b>\$2004</b>
RECITER from Atari BASIC	<b>8199</b>	<b>\$2007</b>
RECITER from machine language	<b>8203</b>	<b>\$200B</b>
SPEED (LIGHTS OFF)	<b>8208</b>	<b>\$2010</b>
SPEED (LIGHTS ON)	<b>8206</b>	<b>\$200E</b>
PITCH (LIGHTS OFF)	<b>8209</b>	<b>\$2011</b>
PITCH (LIGHTS ON)	<b>8207</b>	<b>\$200F</b>
DMA-enable	<b>8210</b>	<b>\$2012</b>
ERROR	<b>8211</b>	<b>\$2013</b>
ATASCII STRING	<b>8212</b>	<b>\$2014</b>

# LISTING OF GUESSNUM

```
10 REM -- GUESSNUM --
20 DIM SAM$(255),B$(50),C$(50)
30 SAM=8192:REM SAM'S ADDRESS
40 GRAPHICS 2?: #6;"GUESS THE NUMBER":? #6;"BETWEEN 1 AND 100"
50 SETCOLOR 2,0,0
60 N=INT(99*RND(0))+1
70 SAM$="GEH3S DHAX NAH4MBER BIXTWIYSN WAH4N Q AEND WAHN6 /HAH4NDRIHD.":A=USR(SAM)
80 TRAP 80:INPUT G
90 IF G>99 THEN SAM$="DHAETS MOH4R DHAEN WAHN /HAH4NDRIHD.":A=USR(SAM):GOTO 80
100 IF G<1 THEN SAM$="DHAESTS LEH3S DHAEN WAH5N.":A=USR(SAM):GOTO 80
110 SAM$=""
120 IF G<10 THEN B$="":GOTO 340
130 ON G-9 GOTO 150,160,170,180,190,200,210,220,230,240
140 GOTO 250
150 B$="TEH4N":GOTO 460
160 B$="IHLEH4VIXN":GOTO 460
170 B$="TWEH4LV":GOTO 460
180 B$="THER4TIY6N":GOTO 460
190 B$="FOH4RTIY6N":GOTO 460
200 B$="FIH4FTIY6N":GOTO 460
210 B$="SIH4KSTIY6N":GOTO 460
220 B$="SEH4VUNTIY6N":GOTO 460
230 B$="EY4TIY6N":GOTO 460
240 B$="NAY4NTIY6N":GOTO 460
250 ON INT(G/10)-1 GOTO 260,270,280,290,300,310,320,330
260 B$="TWEH4NTIY6":GOTO 340
270 B$="THER4TIY6":GOTO 340
280 B$="FOH4RTIY6":GOTO 340
290 B$="FIH4FTIY6":GOTO 340
300 B$="SIH4KSTIY6":GOTO 340
310 B$="SEH4VUNTIY6":GOTO 340
320 B$="EY4TIY6":GOTO 340
330 B$="NAY4NTIY6"
340 R=G-10*INT(G/10)
350 IF R=0 THEN GOTO 460
360 ON R GOTO 370,380,390,400,410,420,430,440,450
370 B$(LEN(B$)+1)="WAH5N":GOTO 460
380 B$(LEN(B$)+1)="TUW5":GOTO 460
390 B$(LEN(B$)+1)="THRIYS ":"GOTO 460
400 B$(LEN(B$)+1)="FOHRS ":"GOTO 460
410 B$(LEN(B$)+1)="FAY5V ":"GOTO 460
420 B$(LEN(B$)+1)="SIHSKS":GOTO 460
430 B$(LEN(B$)+1)="SEH5VUN":GOTO 460
440 B$(LEN(B$)+1)="EY5T":GOTO 460
450 B$(LEN(B$)+1)="NAY5N"
460 IF G>N+25 THEN C$=" IHZ MAH3CH TUW5 /HAY6.":GOTO 530
470 IF G>N+5 THEN C$=" IHZ TUW3 /HAY,6":GOTO 530
480 IF G>N THEN C$=" IHZ AH LIH3TUL TUW4 /HAY6.":GOTO 530
490 IF G>N-25 THEN C$=" IHZ MAH3CH TUW4 LAXOW.":GOTO 530
500 IF G>N-5 THEN C$=" IHZ TUW3 LAXOW.":GOTO 530
510 IF G>N THEN C$=" IHZ AH LIH3TUL TUW4 LAXOW.":GOTO 530
520 IF G=N THEN C$=? YUW3 AAR RAY2IH7T.":GOTO 530
530 SAM$(LEN(SAM$)+1)=B$:SAM$(LEN(SAM$)+1)=C$:A=USR(SAM)
540 IF G>N THEN GOTO 80
550 ? :? :? :? :? :? :GOTO 60
```

## SELDOM-USED PHONEME COMBINATIONS

Phoneme Combination	You probably want:	Unless it splits syllables like:
GS	GZ e.g. bags	bugspray
BS	BZ e.g. slobs	obscene
DS	DZ e.g. suds	Hudson
PZ	PS e.g. slaps	—
TZ	TS e.g. curtsy	—
KZ	KS e.g. fix	—
NG	NXG e.g. singing	ingrate
NK	NXK e.g. bank	Sunkist

## **FUTURE IMPROVEMENTS**

Improvements upon and modifications to the S.A.M. system may occur in the future. Such new versions of S.A.M. will be made available at nominal cost to registered S.A.M. owners.

We are also planning to release a new program called "SUPRECITER". RECITER presently has a pronunciation accuracy of about 90%. SUPRECITER will show a major improvement in this area. But, we need your help.

If you hear a word mispronounced by RECITER that you feel is important, jot it down. Send us your list of these words (or proper names) so that we may incorporate them into the expanded rule set of SUPRECITER. Your contributions will be greatly appreciated.

S.A.M. is an ongoing project at DON'T ASK Computer Software. We welcome your comments and suggestions on our software speech synthesis products.

## **NOTES**

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